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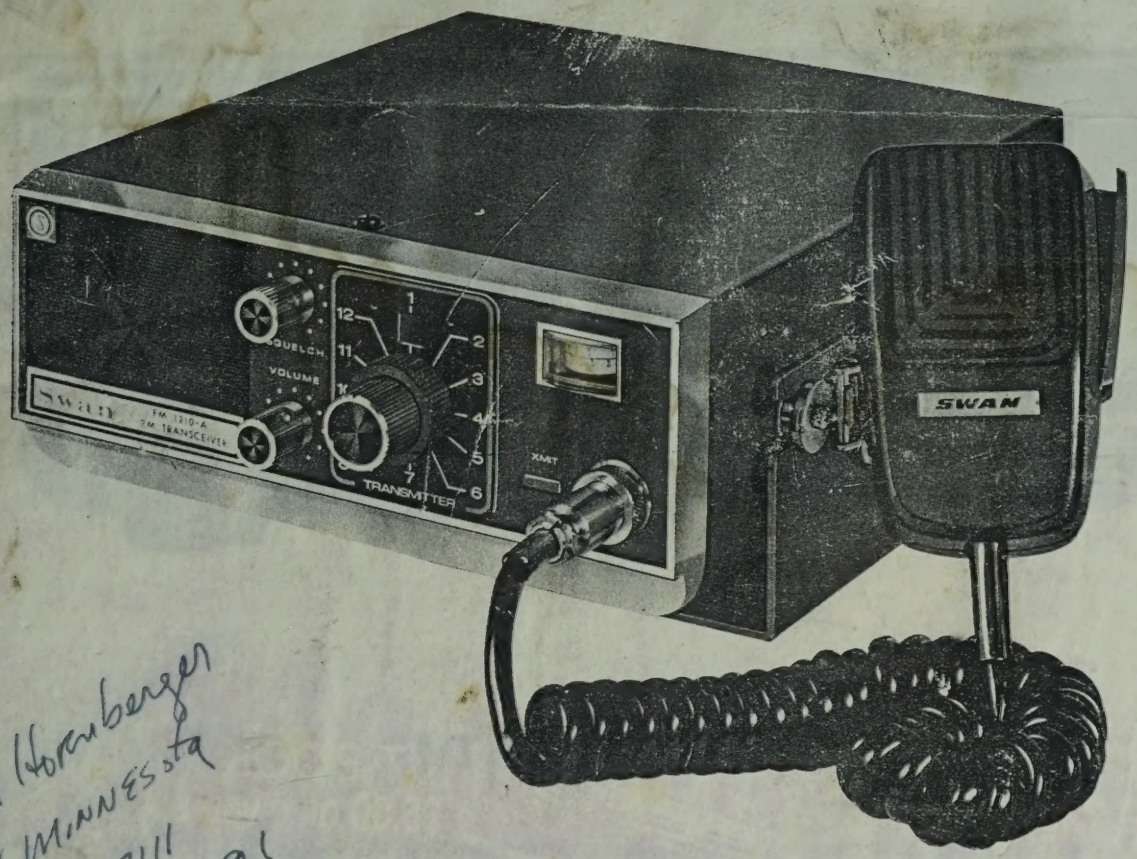
OPERATION AND MAINTENANCE



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St. L, Mo 63111
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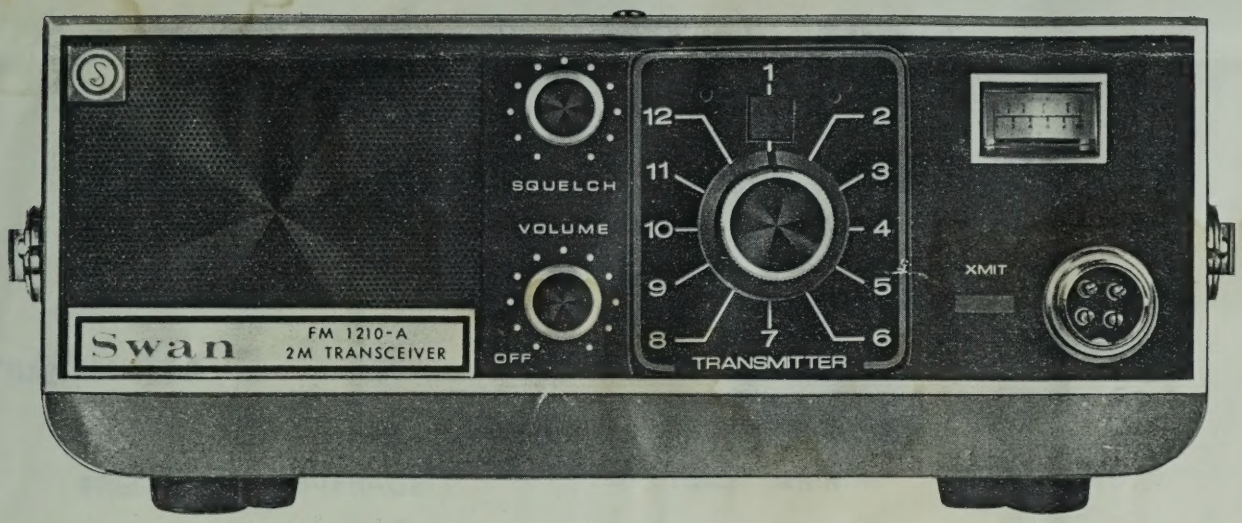
SWAN FM1210-A

SWAN
ELECTRONICS
OCEANSIDE, CALIFORNIA
A subsidiary of Cubic Corporation

1-800-854 1927

OPERATION AND MAINTENANCE SWAN FM1210-A 2 METER FM Transceiver



INTRODUCTION

The Swan FM1210-A 2 meter FM transceiver is a high quality product designed for no compromise performance. Using the popular frequency modulation system, it provides noise free mobile or home station operation in your local area, or through the use of a repeater the FM1210-A can provide you with wide area coverage.

By utlization of a FET in the front end, excellent sensitivity is achieved with excellent cross-modulation and overload characteristics. Outstanding adjacent channel rejection is achieved through the use of a crystal filter in the 16.9 MHz I.F.

The transmitter section of the FM1210-A incorporates a unique IDC (instantaneous deviation control) to prevent over deviation when the unit is over modulated, and pre-emphasis to increase effective range. The output transistor in the FM1210-A is completely protected from open or shorted antennas by a circuit that senses incorrect loads, and removes drive from the early stages of the unit.

The FM1210-A is furnished with everything you need to get on the air, with the exception of an antenna.

SWAN FM 1210-A SPECIFICATIONS

RECEIVER

CIRCUIT TYPE	:	Dobule Superheterodyne
FREQUENCY COVERAGE	:	144 - 148 MHz
BUILT-IN FREQUENCIES	:	Ch. 1 - 146.28, Ch. 2 - 146.88 Ch. 3 - 146.76, Ch. 4 - 146.94
SENSITIVITY	:	.5 uv for 20 db quieting
SELECTIVITY	:	6dB down at ± 6 KHz 80dB at ± 25 KHz
AUDIO OUTPUT	:	1.5 Watt (Distortion: 10%)
SQUELCH SENSITIVITY	:	Less than 0.3 uV

TRANSMITTER

TYPE OF WAVE	:	Frequency modulation (F3)
FREQUENCY COVERAGE	:	144. - 148 MHz
BUILT-IN FREQUENCIES	:	Ch. 1 - 146.22, Ch. 2 - 146.34 Ch. 3 - 146.76, Ch. 4 - 146.94
ANTENNA OUTPUT POWOR	:	10 Watt (at 13.8V)
FINAL-STAGE INPUT POWER	:	20 Wat (at 13.8V)
MODULATION METHOD	:	Variable reactance phase modulation
FREQUENCY DEVIATION	:	7 KHz (Maximum) at 1 KHz. Factory adjusted to 5KHz (−0, +1KHz)
OSCILLATING METHOD	:	Crystal oscillation
MULTIPLICATION METHOD	:	× 3 × 2 × 2 = 12 multiple
OUTPUT IMPEDANCE	:	50 - 75 Ohms
SPURIOUS RESPONSE	:	−60 dB or better

GENERAL

Microphone	:	Press-to-talk dynamic microphone (600 ohm)

CIRCUIT THEORY OF OPERATION

While reviewing this theory of operation, it is suggested that either the schematic diagram or the block diagram be followed for clarity of thought.

RECEIVER SECTION

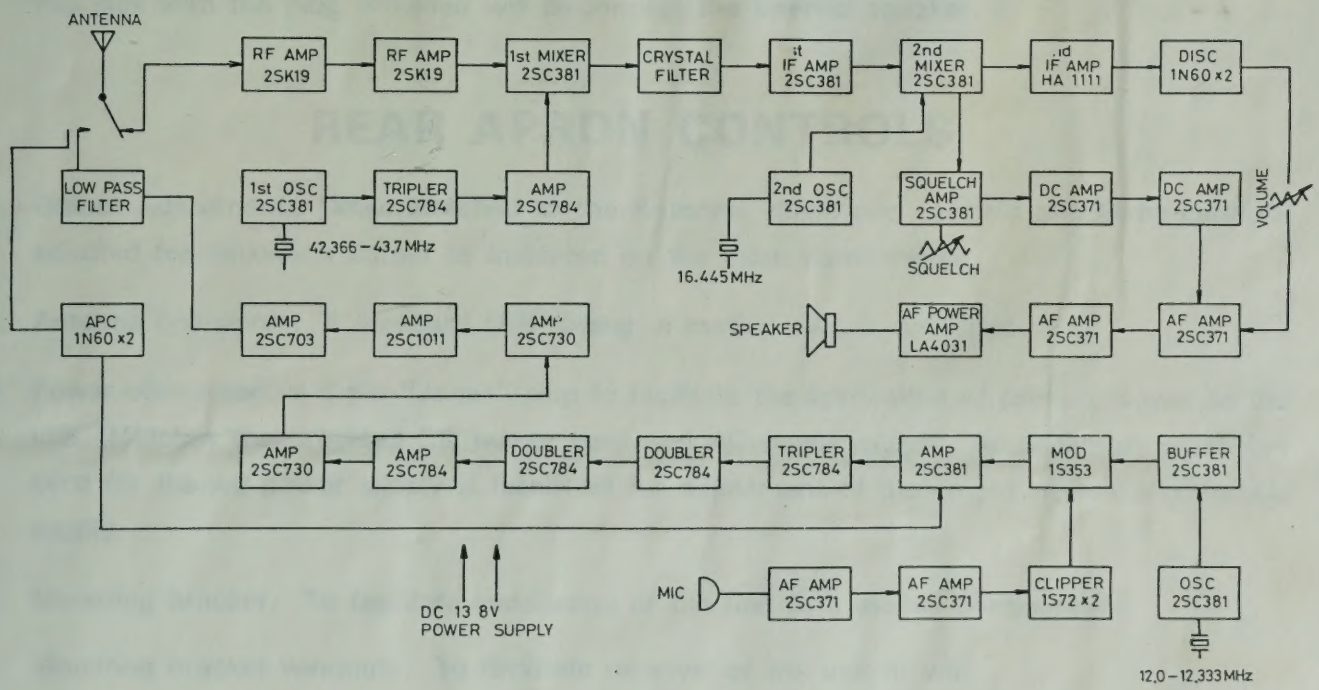
A 144-148 megahertz signal appearing on the ahtenna terminals of the transceiver is first amplified by the RF amplifier stages Q101 and Q102. These two stages are stagger-tuned to provide full sensitivity across the entire 4 megahertz range. From there the signal is passed to the base of Q106 where it is mixed with a signal in the 127.1 to 131.1 megahertz range that is provided by the 1st oscillator, Q103 and its associated tripler, Q104 and passed through the buffer amplifier, Q105. After passing through the 1st mixer, Q106 selectivity is obtained by passing the 16.9 megahertz signal through the crystal filter. The 16.9 megahertz signal is passed to the 1st IF amplifier, Q107. From there the signal is passed to the base of Q109, the second mixer where it is converted to 455 kilohertz by injection of the 2nd oscillator frequency of 16.445 megahertz. From the 2nd mixer the 455 kilohertz signal is passed through the integrated circuit IF amplifier, Q115. After amplification and limiting by Q115, the signal is detected by the discriminator diodes D101 and D102. The detected audio from the discriminator is passed through VR101 the volume control, and into the base of the 1st audio amplifier, Q113. Further amplification is obtained from the audio driver Q114 and is applied to the integrated circuit of the audio output amplifier. Final audio amplification is provided by the integrated circuit, Q116 and into the speaker. Squelch action is derived from the IF signal appearing. This signal is then detected by diode D103 and further amplified by Q111 and this signal is passed to the squelch switch, Q112, that supplies the biasing for the audio transistor, Q113. Received signal strength is metered by the signal that appears on the collector of Q110 and is rectified by diodes D120 and D122.

TRANSMITTER SECTION

The transmitted signal originated from a crystal controlled oscillator, Q201 and crystals in the 12 megahertz range are used in the FM1210-A. The output from Q201 is fed to Q202 where phase modulation of this signal takes place, and the modulation signal is provided as follows.

The input from the microphone is fed through VR203, which is both a microphone gain and deviation level control. This audio signal is fed to the base of Q213 where it is amplified, and passed to Q212 for further amplification. The audio signal at this stage is fed to the deviation limiting device, which is a combination of diodes D203 and D204. These diodes perform a limiting action that is adjusted by means of VR201 and VR202 to prevent over deviation of the unit under high audio inputs. This signal is fed into the secondary side of L201 where phase modulation of the twelve megacycle signal is achieved through the variation of inter electrode capacitance of D202,

this signal is then passed to the base of Q203 which acts as a buffer stage to provide maximum stability of the crystal oscillator. From here the twelve megacycle signal is passed through Q204, where it is tripled to 36 megacycles via the transformers L204 and L205, the signal is fed to the base of Q205 where it is doubled to the 72 megacycle range from the collector of Q205, the signal is coupled to the base of Q206 through transformers L206 and L207. Q206 is another doubler and places our signal in the 2 meter range or 144 to 148 megacycles. At this point the signal is further amplified by Q207, 208, and 209 and fed to the base of the driver transistor, Q210. The output of Q210 is fed to the base of Q211 where final output is attained. From this point the output of Q211 is fed through the pi network comprised of VC219, L226 and VC220, and passed through the low pass filter comprised of C288, L227, C276, L228, and C287. At this point the signal is applied to the output terminal and is radiated. A no antenna or shorted condition is detected by the automatic protection circuitry as comprised primarily of diodes D301 and D302 and their associated components. Sensitivity of this circuitry is determined by VR301 and 302. Should an open or shorted antenna condition exist, this circuitry biases off Q203 and prevents damaged to any of the high level stages of the transmitter.



VHF/FM TRANSCEIVER BLOCK DIAGRAM
MODEL: Swan FM 1210-A

Figure 1

BLOCK DIAGRAM

CONTROLS AND FUNCTIONS

1. Speaker — built in 4 ohm speaker.
2. Squelch — This control adjusts the squelch threshold, and should be adjusted in a clockwise direction until background noise just disappears. If this control is advanced further, weaker signals will not break the squelch.
3. Channel Indicator: This control may be rotated in any direction for the selection of the desired channel 1 through 12.
4. Meter: Indicated relative output in transmit, and received signsl strength in receive.
5. Microphone connector: Matched the microphone supplied with the unit.
6. On-Off/Volume: Rotation of this control in a clockwise direction turn the unit on and increase the Audio volume.
7. External speaker jack: In the event an external speaker is desired at a remote location, using this jack with the plug provided will disconnect the internal speaker.

REAR APRON CONTROLS

8. Output Adjustment: While attached to the Antenna, these two controls should be carefully adjusted for maximum output as indicated on the front panel meter.
9. Antenna connector: A standard UHF fitting, a mating plug is furnished.
10. Power connector: a 6 pin "Jones" plug to facilitate the application of primary power to the unit. Matches the provided DC power cord and AC power supply. An accessory extension cord for the AC power supply is furnished for adjustment of the output while using the AC supply.
11. Mounting bracket: To facilitate installation of the unit in a mobile configuration.
12. Mounting bracket wingnuts: To facilitate removal of the unit at will.

INSTALLATION AND OPERATION

If you are new to 2 meter FM operation, a few words may help you to understand your new equipment, and thus get the most pleasure from it's operation.

First of all, it is important to understand that 2 meter operation provides primarily line of sight communications. However, under certain atmospheric conditions, long range communications are possible in this frequency range. Since you will be most concerned with the line of sight type of communications, our discussion will deal only with this type of operation.

Your anntenna should be given a lot of thought. Are you interested in covering only in one direction or all directions? If omni-directional operation is desired, vertical polarization is used nationwide due to the simplicity of mobile vertical antennae. If possible, you should install the antenna at the highest point accessable to you. If it is your automobile, the antenna should be placed on the roof in the center. If this is not possible, then the center of the trunk lid is the next most desirable location. A "Gain" antenna will greatly increase range, and the most widely used is the 5/8 wave antenna for mobile application. A 5/8 wave mobile antenna is approximately 47" long, and requires a matching network at the base of the antenna to provide the necessary 50 ohm load to your Swan FM1210-A. In home station applications, the 5/8 wave antenna is also very popular, and is used with a ground plane of 1/4 wave radials. The 5/8 wave antenna gives approximately 3 db of gain and an extremely low angle of radiation. Omni-directional antennas of up to 9 db of gain are readily available on the market for home station use.

If you want point to point communications in one given direction, then the yagi or other high gain arrays may be used. There are any number of this type available, and vertical or horizontal polarization may be used. Again, get the antenna as high as possible.

MOBILE INSTALLATION OF THE FM1210-A

Select a convenient location for the transceiver that will provide ease of reach, and not interfere with the operating controls of your vehicle. Mark the surface where the bracket is to be installed, and drill the 4 holes for the self-tapping sheet metal screws using a 1/32" drill bit. Install the bracket. If possible, mount the bracket on a sheet metal surface. If you have only plastic available to mount the bracket on, use bolts and nuts with large washers.

Install the power cord to a 12VDC source that is preferrably energized by the ignition switch to prevent leaving the unit turned on by accident. The red lead of the power cord should be attached to the positive source, and the black lead to ground.

CAUTION: The FM1210-A is designed for operation from a Negative ground electrical system only.

The transceiver installation is complete, and need only the application of a proper antenna for operation.

HOME STATION INSTALLATION

Home station installation requires use of the matching AC power supply and a suitable 2 meter antenna. Once the unit has been plugged into the AC mains, and the antenna installed, you are ready for 2 meter FM operation.

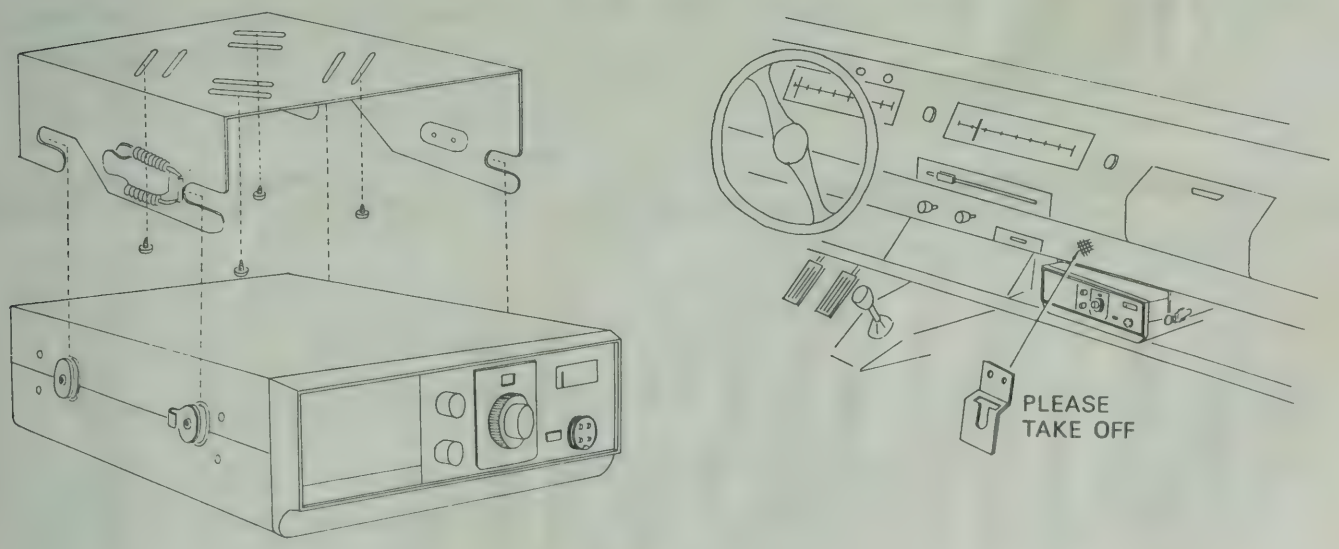


Figure 2

MOBILE MOUNTING

APC (automatic final transistor protective circuit)

This circuit has been factoty adjusted, and should require no further field adjustment. However. if for any reason it should become necessary to readjust this circuitry, the following procedure should be adhered to.

1. Rotate VR 302 completely clockwise (wiper toward ground).
2. Connect a 20,000 ohm per volt VOM across VR302 and set range switch on VOM for 10 volts DC.
3. Connect a normal antenna or 50 ohm dummy load.
4. Key the transceiver and adjust VR301 for minimum reading on the VOM.
5. Remove the meter and disconnect the antenna.
6. Key the transceiver and adjust VR302 for a "O" reading on the front panel meter.
7. Short the antenna terminal and be sure the unit indicates "O" on the meter when keyed. Adjustment is now complete.

ADDITION OF NEW CHANNELS

The FM1210-A is furnished to you with the following channel frequencies:

Channel	Transmit	Receive
1	146.22 MHz	146.28 MHz
2	146.34	146.88
3	146.76	146.76
4	146.94	146.94

If additional frequency coverage is desired, the following information is given. Crystal frequency determining formulae

Transmit crystals

$$\text{crystal frequency} = \frac{\text{desired frequency}}{12}$$

25pf parallel resonant HC-25/u pin type.
Grinding tolerance 0.01%.
Temp. Tolerance 0.005% -10 to +60 Deg C

Receive crystals

$$\text{crystal frequency} = \frac{\text{desired frequency} - 16.9 \text{ mHz}}{3}$$

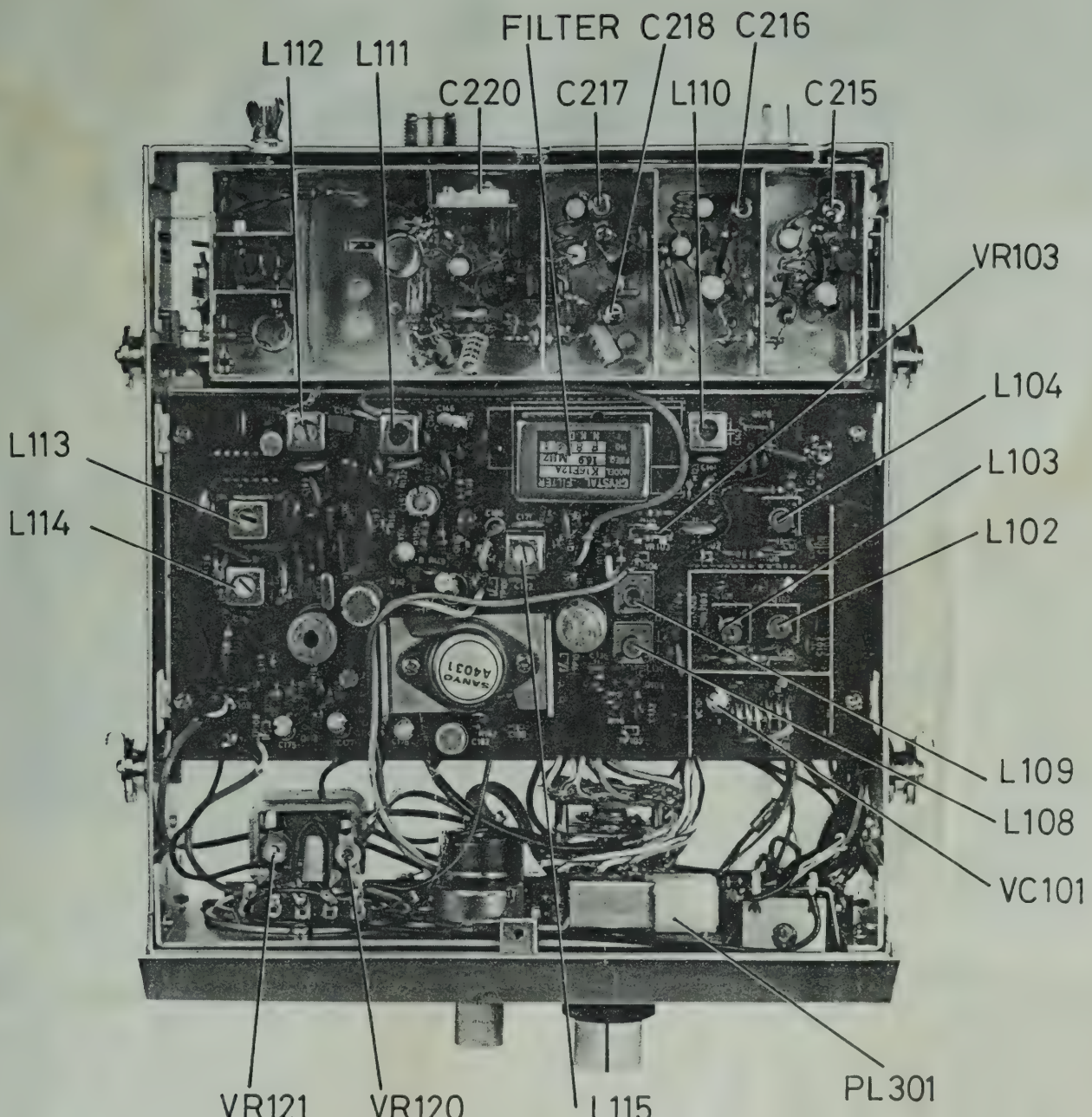
32pf parallel resonant HC-25/U pin type.
Tolerance same as transmit crystals.

To install the crystals in the unit, remove the bottom cover of the cabinet and install in the socket desired. To adjust the crystal to exact frequency, use the corresponding ceramic trimmer capacitor.

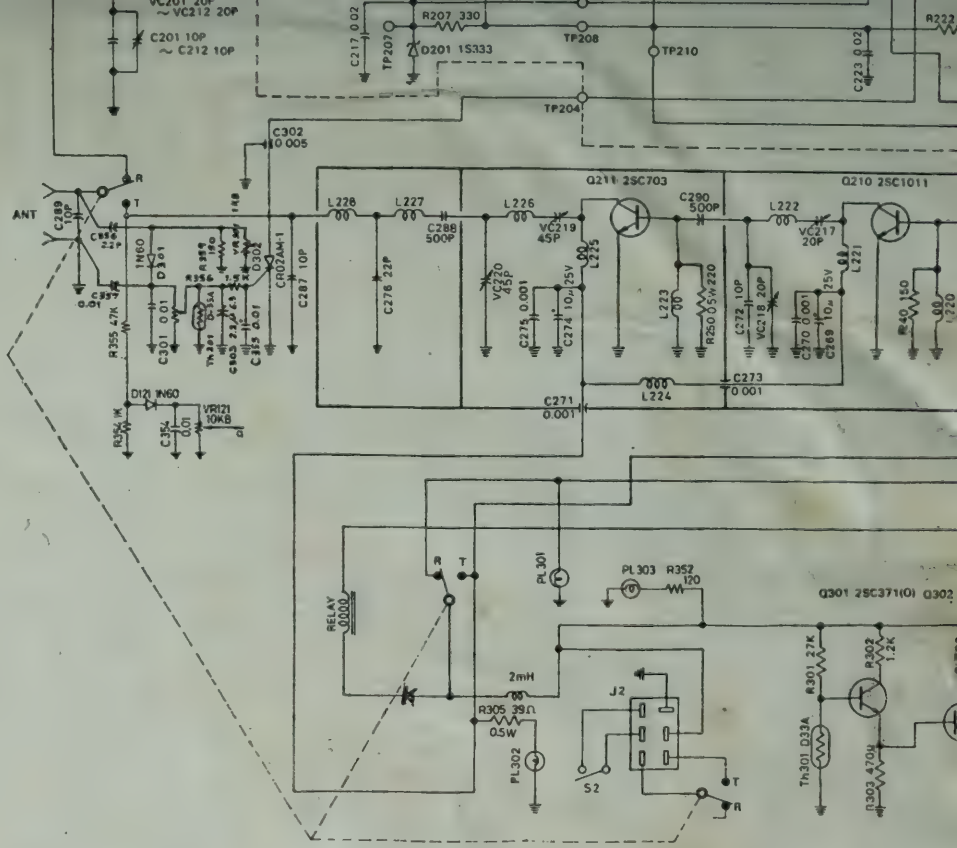
TROUBLESHOOTING

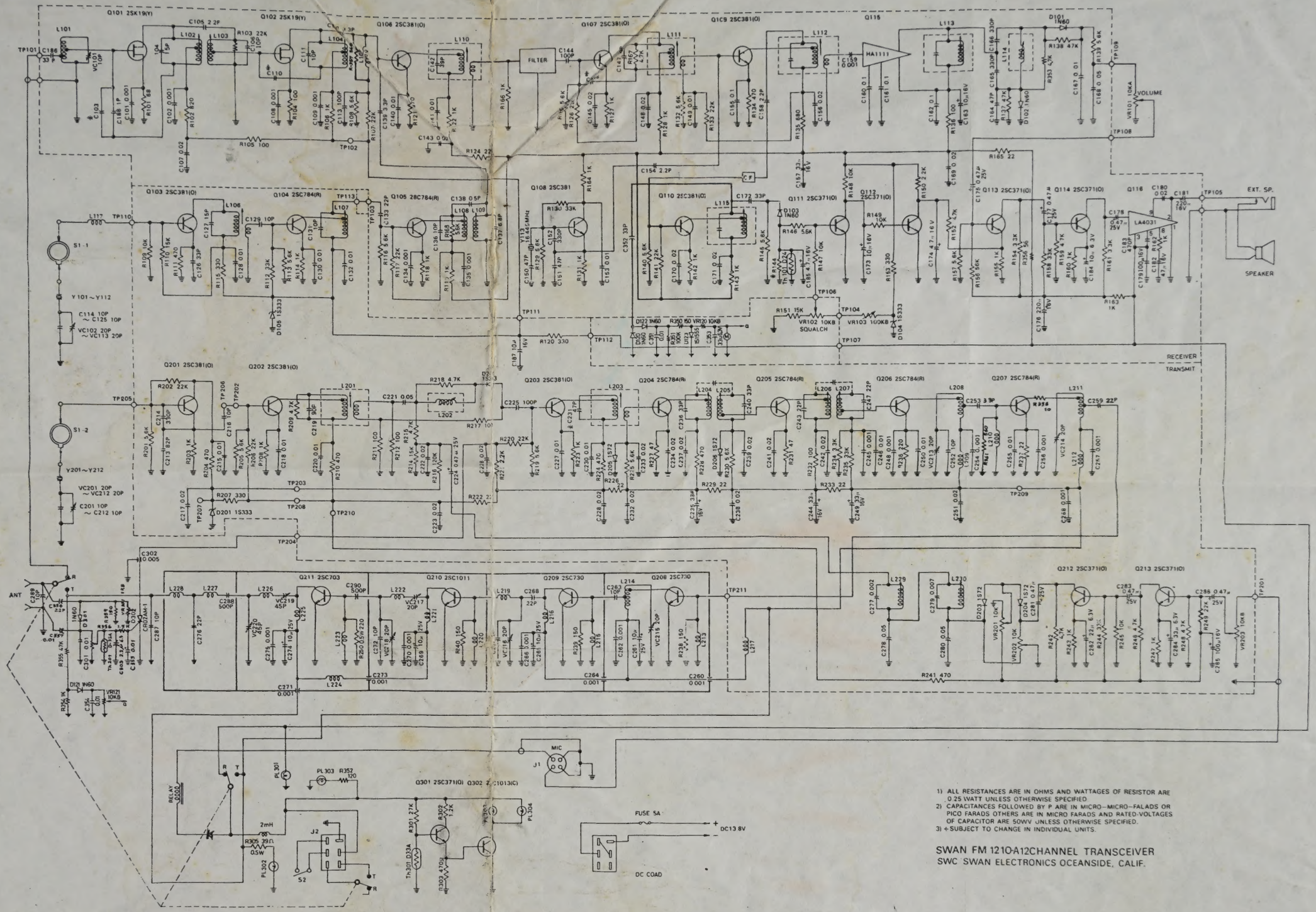
Symptom	Check	Cure
No transmit/receive	Is unit plugged into power source. . . . . fuse?	Plug into AC mains or 12VDC source. Replace fuse if blown.
Works on some channel but not others	Defective crystal. . . Loose crystal contact.	Replace crystal. . . . Tighten crystal socket with sharp tool.
Receive ok — no transmit	APC circuit disabling transmit. Bad mic contact.	Antenna defective — correct. Clean contacts on mic connector.
Unit performs, no pilot lamps.	Pilot lamps burned out.	Replace with spares furnished.

As with any other piece of electronics equipment, failures are bound to occur. To assist you in repairs, a schematic diagram is included with this manual. Normal troubleshooting procedures should be used. If you are unable to diagnose a problem, and require assistance, feel free to contact our customer service department for further information. If for any reason you find it necessary to return the unit to the factory for service, please obtain a return authorization prior to shipping the unit to us.


FILTER
C218
C216
L112
L111
C220
C217
L110
C215
VR103
L104
L113
L103
L114
L102
L109
L108
VC101
PL301
VR121
VR120
L115

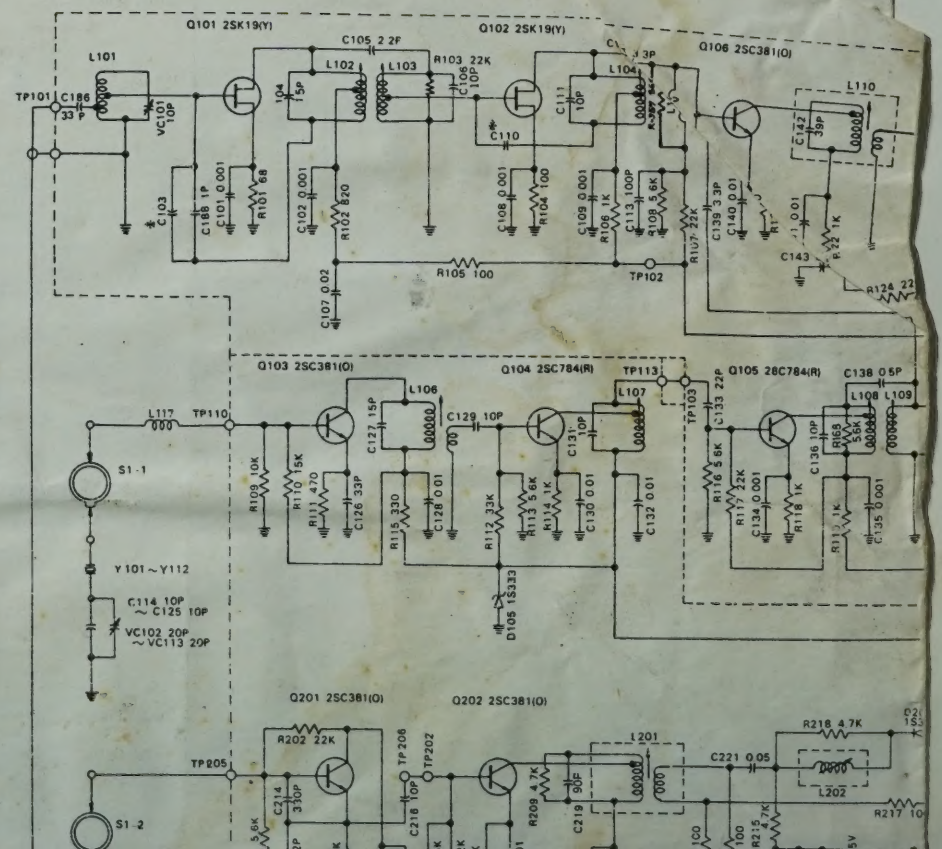
TOP VIEW

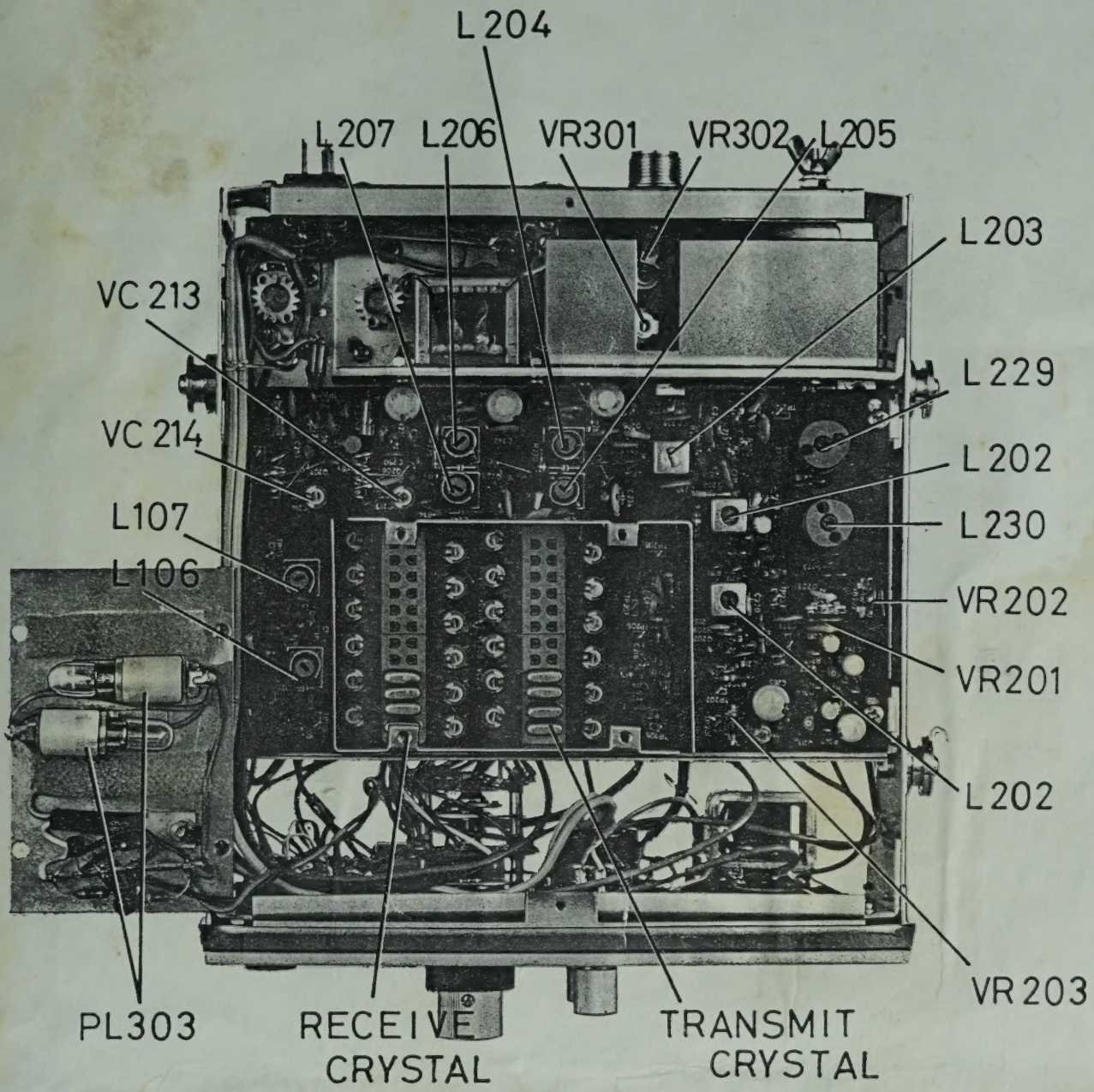

VC201 20P ~ VC212 20P
C201 10P ~ C212 10P
C217 0.02
TP207
R207 330
D201 1S333
TP208
TP210
C223 0.02
TP204
C302 0.005
ANT
C289 10P
C290 2P
C291 4P
T
R
IN60 D301
R355 47K
C301 0.01
R356 0.5K
R357 2.2K
C302 0.01
CR02AM-1
C287 10P
L228
L227
L226
C288 500P
C276 22P
VC219 45P
VC220 45P
C275 0.001
C274 10 25V
L225
Q211 2SC703
C290 500P
L222
VC217 20P
Q210 2SC1011
L223
R250 0.5W 220
C272 10P
VC218 20P
C270 0.001
C269 10 25V
L221
R249 150
L220
C273 0.001
L224
C271 0.001
D121 IN60
R354 1K
C354 0.01
VR121 10KB
RELAY 0000
PL301
PL303 R352 120
Q301 2SC371(O) Q302
2mH
R305 39Ω 0.5W
PL302
J2
S2
R301 27K
R302 1.2K
Th301 D33A
R303 470H



1) ALL RESISTANCES ARE IN OHMS AND WATTAGES OF RESISTOR ARE 0.25 WATT UNLESS OTHERWISE SPECIFIED.
2) CAPACITANCES FOLLOWED BY P ARE IN MICRO-MICRO-FALADS OR PICO FARADS OTHERS ARE IN MICRO FARADS AND RATED-VOLTAGES OF CAPACITOR ARE 50WV UNLESS OTHERWISE SPECIFIED.
3) ÷ SUBJECT TO CHANGE IN INDIVIDUAL UNITS.

SWAN FM 1210-A12CHANNEL TRANSCEIVER
SWC SWAN ELECTRONICS OCEANSIDE, CALIF.


Q101 2SK19(Y)
Q102 2SK19(Y)
Q106 2SC381(O)
L101
TP101
C186 33P
VC101 10P
C105 2.2P
L102
L103
R103 22K
C106 10P
L104
C111 10P
C110
L110
C142 39P
C103
C188 1P
C101 0.001
R101 68
C102 0.001
R102 820
C107 0.02
C108 0.001
R104 100
C109 0.001
R108 1K
C113 100P
R109 5.6K
R107 22K
C139 3.3P
C140 0.01
C143
R124 22
R105 100
TP102
Q103 2SC381(O)
Q104 2SC784(R)
TP113
Q105 2SC784(R)
C138 0.5P
L108 L109
L117
TP110
L106
C127 15P
C129 10P
L107
C131 10P
TP103
C133 22P
C136 10P
R168 56K
S1-1
R103 10K
R110 15K
R111 470
C126 33P
C128 0.01
R115 330
R112 33K
R113 5.6K
R114 1K
C130 0.01
C132 0.01
R116 5.6K
R117 2.2K
C134 0.001
R118 1K
R119 1K
C135 0.001
Y101~Y112
C114 10P ~ C125 10P
VC102 20P ~ VC113 20P
D105 1S333
Q201 2SC381(O)
Q202 2SC381(O)
R202 22K
TP205
TP206
TP202
L201
R218 4.7K
C221 0.05
L202
S1-2
C214 330P
C216 10P
R209 4.7K
C219 90P
R217 10
R215 4.7K


L204
L207
L206
VR301
VR302
L205
L203
VC213
L229
VC214
L202
L107
L230
L106
VR202
VR201
L202
VR203
PL303
RECEIVE CRYSTAL
TRANSMIT CRYSTAL

BOTTOM VIEW

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